

H13 Die Softening in Service

Softening is what starts a thermal fatigue crack, because a softened surface can no longer carry the thermal stress. The table below gives the temperature, the hardness and the cracking for four melt contact times, together with the re-heat treatment that restores the resistance.

Reference only. This is a reference summary of a published study and it is not a specification of ours. The values are reproduced from the source, which tested one grade, one specimen shape and one set of casting conditions. What a particular die reaches depends on the die design, the alloy, the cycle and the cooling circuit. Final design is confirmed on the job.

Softening is what starts the crack

The hardness ahead of the crack tracks the temperature

Item	5 sec	7 sec	9 sec	12 sec
Maximum temperature at the corner, F	926	991	1087	1147
Hardness at the corner, 0.01 in in, HRC	36.9	33.8	24.5	24.3
Hardness ahead of the average maximum crack, HRC	36.9	33.8	31.6	29.2
Total crack area, x 10 ⁶ μm ² , after 15,000 cycles	1.97	5.9	108.56	167.72

The temperature, the hardness and the cracking for four immersion times, all in one premium grade H13 specimen series at 15,000 cycles. Hardness ahead of the crack is measured at a distance from the corner equal to the average maximum crack length.

Bringing the hardness back before the cracks start

Softening that runs ahead of the tempering curve

What this means on the job

Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, DC53, A2, O1, H13, H11, H10, H21, S7, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.

Source, Effect of Design Factors on Thermal Fatigue Cracking of Die Casting Dies, D. Schwam, J. F. Wallace and S. Birceanu, Case Western Reserve University, final technical report to the U.S. Department of Energy, Award No. DE-FC07-00ID138486, October 2004.

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